REMARKS/ARGUMENTS

Claims 1-44 were previously pending in this application and claim 45 has now been added. Claims 11, 13, 14, 36-39 and 44 were previously withdrawn from consideration. Claims 1-10, 12, 15-35 and 40-43 have been rejected. Claim 1, 8, 9 and 20 are being amended and claims 11, 13, 14, 36-39 and 43-44 are being cancelled. Applicants respectfully request allowance of each of pending claims 1-10, 12, 15-35, 40-42 and 45.

I. Rejection of Claims 1-10, 12, 15-24, 32 and 34-35 Under § 103

In the Office action, particularly on page 3, first paragraph, claims 1-10, 12, 15-24, 32 and 34-35 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Canata et al., "Size Classification of silicon nanocrystals" (hereinafter "Camata") in view of Wu et al., "A Method for the Synthesis of Submicron Particles" (hereinafter "Wu") and further in view of Littau et al., "A Luminescent Silicon Nanocrystal Colloid via a High-Temperature Aerosol Reaction" (hereinafter "Littau"). Applicants respectfully submit that these claim rejections are overcome based on the reasons set forth below.

Amended independent claim 1 recites the features of:

> "forming an original plurality of discrete semiconductor particles . . . and thereby forming an aerosol, substantially all of said original plurality of discrete semiconductor particles having a diameter less than 20 nanometers";
>
> "*densifying* said original plurality of discrete semiconductor particles by heating said aerosol in a substantially oxygen-free environment to a sufficiently high temperature . . . and thereby forming a *corresponding* plurality of densified discrete semiconductor particles entrained in a gas"; and
>
> "forming an electrically insulating cover on *each* of said plurality of densified discrete semiconductor particles, thereby forming a *corresponding* plurality of insulator-coated densified discrete semiconductor particles."

Applicants respectfully point out that the reference oft-referred to in the Office action as the "Canata" reference, is actually the "Camata" reference as will be referred to hereinafter.

As conceded in the Office action, Camata does not disclose forming an electrically insulating cover on the particles or densifying the particles. Camata further fails to disclose heating an aerosol to a sufficiently high temperature that might densify the particles. The secondary reference of Littau has apparently been relied upon for disclosing a second oxidation oven to form an oxide coating on the particles but Littau, like Camata, does not disclose or suggest densifying the particles.

The Office action further states that Wu "discloses an aerosol forming reactor composed of sections in which the particles are heated to a sufficiently high temperature to densify said particles such that substantially all of said particles includes a density substantially as great as the bulk density of said semiconductor material and thereby forming a corresponding plurality of densified discrete semiconductor particles entrained in a gas (see temperature of zone 4 in fig. 1)", subject Office action, page 4, lines 8-12.

Applicants respectfully point out that Wu, however, does not disclose or suggest ***densifying*** previously formed particles as does the claimed invention. Amended independent claim 1 recites "densifying said original plurality of discrete semiconductor particles". It is inherent from this language that the particles existed, i.e., were formed prior to the densifying step. In fact, Wu *teaches away* from densifying previously formed, nanoparticles as Wu is directed to forming a low concentration of dense particles. See Wu, page 266, paragraph bridging columns 1 and 2, which states that physical vapor deposition forms dense particles and avoids low-density flocs of agglomerated particles. Since the particles in Wu are formed by vapor-phase physical deposition, the particles are dense upon formation and Wu avoids the need to separately densify the particles. Indeed, Wu points to the difficulty in subsequent processing when direct growth of dense particles is not achieved. See Wu, paragraph

2, page 266. The high temperatures in zone 4 of Wu pointed out in the Office action, are used to crystallize the particles, not densify them. Applicants respectfully point out that crystallization and densification are different physical processes. (Amended dependent claim 8 recites the further feature of forming crystalline material.) Wu does not teach densifying a previously formed plurality of particles because the particles in Wu are dense as formed.

Amended independent claim 1 also recites the feature: "substantially all of said original plurality of discrete semiconductor nanoparticles having a diameter less than 20 nanometers". Wu is directed to particles in the 0.1 micron size range. As such, Wu does not teach or suggest densifying particles with diameters less than 20 nanometers. Furthermore, Wu does not disclose or suggest the high-temperature zone being an oxygen-free environment. Claim 1 has been amended to recite that the densifying occurs "in a substantially oxygen-free environment". Wu does not disclose or suggest this feature because Wu is directed to larger size particles in which an oxygen-free environment (and sufficiently low heating times) may not be needed to avoid agglomeration and to densify substantially each of the original plurality of discrete semiconductor particles.

It is because of these features that the process of the present invention prevents re-agglomeration of the nano-sized (less than 20nm) particles and instead provides that substantially all of the original plurality of discrete semiconductor particles become densified and form a corresponding plurality of densified discrete semiconductor particles, each of which are then covered with an electrically insulating cover to form a corresponding plurality of insulator-coated densified discrete semiconductor particles, as also recited in claim 1. The *corresponding* pluralities of particles implicitly claims that *substantially all of the original plurality of formed particles* are maintained, densified and coated. Wu further does not disclose this implicitly claimed feature. In summary the high-temperature step that occurs in zone 4 of the Wu reaction is clearly distinguished from the claimed densifying step of independent claim 1.

The cited reference of Wu therefore does not make up for the above-stated deficiencies of the Camata and Littau references as conceded in the Office action. Amended independent claim 1 is therefore distinguished from the references of Camata, Wu and Littau, taken alone or in combination. Dependent claims 2-10, 12, 15-24, 32 and 34-35 each depend, directly or indirectly, from amended independent claim 1 and are therefore similarly distinguished from the combination of references of Camata, Littau and Wu. Dependent claims 8, 9 and 20 have been amended. The rejection of claims 1-10, 12, 15-24, 32 and 34-35 as being unpatentable over Camata in view of Wu and further in view of Littau, should therefore be withdrawn.

II. Rejection Of Claims 25-28, 33 and 40-43 Under § 103

In the Office action, particularly on page 4, second paragraph, claims 25-28, 33 and 40-43 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Camata in view of Wu and further in view of Littau, as applied to claims 1-10, 12, 15-24, 32 and 34-35 above, and further in view of Yadav et al., U.S. Patent 6,344,271, hereinafter "Yadav". Applicants respectfully submit that these claim rejections are overcome based on the reasons set forth below.

Independent claim 40 recites the feature of "thermophoretically depositing said . . . discrete semiconductor particles on said substrate". Claims 25, 27 and 33 each depend from amended independent claim 1. Claim 25 recites the feature of "thermophoretically depositing said plurality of insulator-coated densified discrete semiconductor particles on said substrate"; claim 27 recites "thermophoretically depositing said stratum"; and, claim 33 recites "electrophoretically depositing said plurality of insulator-coated densified discrete semiconductor particles onto a surface of said substrate".

The Office action concedes that the Camata, Littau and Wu references "fail to expressly disclose using thermophoretic or electrophoretic deposition to form the

nanoparticles". The Office action continues, "Yadav et al. discloses nanoparticles using either of the above mentioned deposition processes (see col. 14-lines 50-67)".

The Office action further states that it would be obvious "to modify the process of Camata et al. modified by Wu et al. and Littau et al. so as to utilize the deposition processes of Yadav et al. because Yadav et al. shows these processes to be suitable processes to form nanoparticles", subject Office action, page 5, lines 5-8. Applicants are unsure as to whether this passage from the Office action is suggesting that the processes of Yadav are used to <u>form</u> the nanoparticles or to <u>deposit</u> the formed nanoparticles. Applicants believe such indefiniteness is likely due to the fact that Yadav neither discloses forming nor depositing nanoparticles using thermophoretic or electrophoretic processing

In particular, the section of Yadav identified in the Office action merely states that

> "Another embodiment of this invention is to prepare devices from non-stoichiometric substances. Devices can be prepared using one of the manufacturing methods used currently in the art or a combination thereof. Examples of processes which can be used at some stage include . . . electrophoretic deposition, thermophoretic deposition . . . The non-stoichiometric material in the device can be porous or dense, thin or thick, flat or curved . . ." (Yadav, col. 14, lines 50-58.)

This represents a laundry list of processes which may be used at some stage to form "devices". Yadav is directed to non-stoichiometric substances that in some cases happen to be formed of <u>*nanostructured*</u> materials (or "<u>*nanomaterials*</u>") which are distinguished from <u>*nanoparticles*</u>. Yadav defines nanostructured materials to be "materials with a domain size less than five times the mean free path of electrons in the given material", Yadav col. 8, lines 59-61. In embodiments of Yadav, the nanostructured materials may be nanopowders which are used to form non-stoichiometric materials but Yadav does not teach the formation of nanoparticles.

Nanomaterials or nanoparticles are not mentioned in the above-cited paragraph of the Yadav specification that introduces "another embodiment" and extends from col. 14, line 50 through col. 14, line 67. Yadav therefore does not "teach" one of ordinary skill in the art how to use the aforementioned processes to deposit anything, much less nanometer-sized particles using thermophoretic or electrophoretic deposition. In particular, Yadav does not "shows these processes to be suitable processes to form nanoparticles" as suggested in the Office action, and Yadav further does not "teach" thermophoretically or electrophoretically depositing a plurality of discrete particles as in the claimed invention.

The Office action has therefore not established a prima facie case of obviousness because the Office action does not present evidence that one having ordinary skill in the art would have been led to combine the relevant teachings of the applied references to arrive at the claimed invention because none of the references adequately teaches using thermophoretic or electrophoretic deposition to deposit particles with diameters less than 20 nanometers.

Claim 33 further recites the feature of "introducing said plurality of insulator-coated densified discrete semiconductor particles into a liquid medium to form a colloid". Yadav further does not disclose the formation of a colloid using the particles, as recited in claim 33.

The cited reference of Yadav therefore does not make up for the deficiencies of the combination of Camata, Littau and Wu, and therefore independent claim 40, dependent claim 33, and dependent 25, as well as claims 26 and 27 which depend from claim 25, and claim 41 which depends from claim 40, are therefore distinguished from the references. The rejection of claims 25-27 and 40 as being unpatentable over Camata, Littau, Wu and Yadav, should therefore be withdrawn.

Claim 28 depends from claim 1 and recites the feature that the deposited stratum "is characterized by a foreign contamination level being less than 10^{11} atoms/cm^2". Yadav does not disclose contamination levels and the Office action does not state that

Yadav discloses or suggests any level of foreign contamination, much less than the claimed foreign contamination level. Claim 28 depends from claim 1, which is distinguished from the references of Camata, Wu and Littau, as discussed above, and Yadav therefore does not make up for the above-stated deficiencies of the combination of Camata, Wu and Littau. Claim 28 is therefore distinguished from the combination of references, Camata, Wu, Littau and Yadav. The rejection of claim 28 should therefore be withdrawn.

Claim 42 depends from claim 1 and recites the feature of encapsulating the particles. Yadav does not disclose encapsulation and the Office action does not state that Yadav discloses or suggests encapsulating particles. Claim 42 depends from claim 1, which is distinguished from the references of Camata, Wu and Littau, as discussed above, and Yadav therefore does not make up for the above-stated deficiencies of the combination of Camata, Wu and Littau. Claims 42 is therefore distinguished from the combination of references of Camata, Wu, Littau and Yadav. The rejection of claim 42 should therefore be withdrawn.

Claim 43 has been cancelled and the rejection of claim 43 is therefore obviated.

III. Newly Added Claim 45

Independent claim 45 has been added to more particularly point out distinguishing features of Applicants' invention and recites "thermophoretically depositing" as well as the distinguishing features of the "densifying" step as discussed above. Claim 45 is therefore distinguished from the references of record and is in allowable form.

IV. Rejection of Claims 29-32 Under § 103

In the Office action, specifically on page 5, second paragraph, claims 29-32 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Camata in view of Wu and further in view of Littau as applied to claims 1-10, 12, 15-24, 32 and 34-35 above, and further in view of Tiwari et al., "Volatile and Non-Volatile Memories in Silicon with

Nano-Crystal Storage", hereinafter "Tiwari". Applicants respectfully submit that these claim rejections are overcome based on reasons set forth below.

The cited reference of Tiwari has apparently been relied upon for providing a nanoparticle based memory including a monolayer of nanoparticles on a tunnel oxide. Tiwari therefore does not make up for the above-stated deficiencies of the combination of the Camata, Wu and Littau references. Since claims 29-32 each depend from independent claim 1, which is distinguished from the combination of the Camata, Wu and Littau references for reasons set forth above, claims 29-32 are each also distinguished from the references of Camata, Wu, Littau and Tiwari, taken alone or in combination, and therefore the rejection of claims 29-32 should therefore be withdrawn.

V. Rejection of Claims 34-35 Under § 103

In the Office action, specifically on page 6, second paragraph, claims 34 and 35 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Camata in view of Wu and further in view of Littau as applied to claims 1-10, 12, 15-24, 32 and 34-35 above, and further in view of Junno, et al., "Controlled Manipulation of Nanoparticles with an Atomic Force Microscope", hereinafter "Junno". Applicants respectfully submit that these claim rejections are overcome based on the reasons set forth below.

The cited reference of Junno has apparently been relied upon for providing an atomic force microscope in order to position nanoparticles with high precision. Junno therefore does not make up for the above-stated deficiencies of the combination of the Camata, Wu and Littau references. Since claims 34 and 35 are each distinguished from the combination of the Camata, Wu and Littau references for reasons set forth above, claims 34 and 35 are each distinguished from the references of Camata, Wu, Littau and Junno, taken alone or in combination, and therefore the rejection of claims 34 and 35 should be withdrawn.

V1. Claims 11, 13, 14, 36-39 and 44

Claims 11, 13, 14, 36-39 and 44, previously withdrawn from consideration, are being cancelled.

CONCLUSION

Based on the foregoing, each of claims 1-10, 12, 15-35, 40-42 and 45 are in allowable form, and the application is therefore in condition for allowance, which action Applicants expeditiously request.

Respectfully submitted,
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